




# ACTIVITY 14



## SMOG

This activity lets students create artificial “smog” in a jar. Teachers can use this module as an introduction to a planned visit from an air-quality scientist, or as the basis for extended discussions on the health problems associated with smog. This activity is related to the warm-up exercises called “Read My Data” and “Seeing the Big Picture.” Related activities include “Lifestyles and the Environment,” “Is Your Air Clean?,” “Deciding To Clean the Air,” and “Choosing a Better Future.”

### CRITICAL OBJECTIVES

-  Recognize that invisible air pollutants and weather conditions are involved in creating smog
-  Understand that not all air pollution is visible
-  Appreciate that human activities can cause air pollution

### SKILLS

-  Observing
-  Drawing conclusions

### GUEST PRESENTERS

Guest presenters could include EPA air quality monitoring specialists, state or local air quality managers, chemists, laboratory technicians, or meteorologists.

### BACKGROUND

The expression “smog” was first used in “Turn-of-the-Century” London to describe a combination of “smoke” and “fog.” Smog occurred when water vapor in the air condensed on small particles of soot in the air, forming small smog droplets. Thousands of Londoners died of pneumonia-like diseases due to the poisonous air. Today, smog is usually produced photochemically, when chemical pollutants in the air (notably nitrous oxide and hydrocarbons from automobile exhausts) are baked by the sun and react chemically. Ground-level ozone is produced by a combination of pollutants from many sources such as automobile exhausts, smokestacks, and fumes from chemical solvents like paint thinner or pesticides. When these smog-forming pollutants (called “precursors”) are released into the air, they undergo chemical transformations and produce smog. Weather conditions, such as the lack of wind or a “thermal inversion,” also cause smog to be trapped over a particular area.

Smog causes health problems such as difficulty in breathing, asthma, reduced resistance to lung infections, colds, and eye irritation. The



### RELATED WARM-UPS

B, C

### REFER TO READING MATERIALS

“Smog”  
“Air Pollution”  
“Ozone”  
“Automobiles and Air Pollution”

### TARGET GRADE LEVEL

3rd - 5th

### DURATION

20 minutes

### VOCABULARY

Hydrocarbons  
Ozone  
Photochemical  
Precursor  
Smog  
Thermal inversion

### MATERIALS

Clean, dry, wide-mouth glass jar (such as a mayonnaise jar)  
Heavy aluminum foil  
Two or three ice cubes  
Ruler  
Scissors  
Stop watch or watch with a second hand  
Matches

ozone in smog also can damage plants and trees, and the haze reduces visibility. This is particularly noticeable from mountains and other beautiful vistas such as National Parks.

Severe smog and ground-level ozone problems exist in many major cities, including much of California from San Francisco to San Diego, the mid-Atlantic seaboard from Washington, DC to southern Maine, and over major cities of the Midwest. (See reading materials on "Smog," "Air Pollution," "Ozone," and "Automobiles and Air Pollution.")



### WHAT TO DO

1. Explain that the class will perform an experiment in which they will create artificial "smog" in a jar. Make sure that students understand that the jar is only a model, and models by nature are limited. For example, the purpose of this model is to illustrate the appearance and behavior of smog, not the composition or effects. It is important to understand that smog is not just a "smoky fog," but a specific phenomenon.
2. Select students to perform the experiment. Have them cut a strip of paper about 6 inches by 2 inches. Fold the strip in half and twist it into a rope.
3. Have them make a snug lid for the jar out of a piece of aluminum foil. Shape a small depression in the foil lid to keep the ice cubes from sliding off. Carefully remove the foil and set it aside.
4. Have the students put some water in the jar and swish it around to wet all the inside of the jar. Pour out the extra water.



**TAKE NOTE!** Be careful to supervise students using matches. DO NOT let anyone breathe the "smog" produced in the experiment, and when the experiment is completed, be sure to release the "smog" outside.

5. Have them light the paper "rope" with a match and drop it and the match into the damp jar. Put the foil lid back on the jar and seal it tightly. Put ice cubes on the lid to make it cold.

(The ice cubes will make the water vapor in the jar condense.) You must do this step very quickly, perhaps with some assistance.

6. Ask students to describe what they see in the jar. How is this like real smog? What conditions in the jar produced "smog"? (Moisture plus soot particles from the burning matches plus carbon dioxide and other solvent vapors.)
7. Ask the students if they have ever seen smog (not fog). Have they ever breathed air outside that smelled funny?

## SUGGESTED EXTENSIONS (OPTIONAL)

- ☀ Have students put a glass thermometer (not plastic) into the jar before they do the experiment. Have them record the temperature before proceeding to step 4. Have them record the temperature during step 5. Ask them to describe what the temperature did and why. Let them try it again without adding water.

## SUGGESTED MODIFICATIONS

- ☀ For grades 7-12, assign students to small groups to answer the following questions and report back to class in two weeks. One group will consider the physical and chemical sciences and the other group will consider the health and ecological sciences. Each group should consider referring to several sources of information to answer the questions. Students could possibly interview the weather reporter or meteorologist at the local television or radio station or airport, or interviewing a health scientist from the city or county health department or air quality agency.

(a) What conditions are necessary to produce smog in the air? Under what circumstances will these conditions exist in the city? How often are they likely? Can they be predicted in advance?

(b) What are the health effects of smog on people? On plants and trees? Why doesn't everyone in the city get sick or have similar symptoms from smog? What types of people are most sensitive to smog?

## SUGGESTED READING

Bailey, Donna. *What Can We Do About Noise and Fumes*. New York: Franklin Watts (1991).

Baines, John. *Exploring: Humans and the Environment*. Austin, TX: Steck-Vaughn Company (1993).

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Pasternak, Judy. "Long-Term Lung Damage Linked to Air Pollution; Respiratory Deterioration Is Found in Areas Where Air Is Dirtiest." *Los Angeles Times*, (29 March 1991) p. A1.

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Scott, Geoff. "Two Faces of Ozone." *Current Health*, 19 (2 September 1992) p. 24.

"Study Finds Source of Canyon Haze." *National Parks*, 63 (July 1989) p. 10.

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